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ABSTRACT

The results of two experimental studies of interference in German-Swedish bilingual and trilingual high school students are presented. Both were developmental studies with length of residence in Sweden as the main independent variable. The purpose was to follow the developmental changes in intra- and interlingual interference and to find out if those interference patterns are related to intelligence as measured by a non-verbal test. In one study, vision tasks were used and in the other, dichotic auditory translation tasks were used. The results of the first study indicate that the differential pattern of interference is mainly determined by language dominance. Equivalent amounts of intra- and interlingual interference occur in subjects with roughly equivalent skills in each language, and higher interference from one language occurs when that language is dominant. The interference pattern is not task dependent, but the task difficulty appears to determine the point of language balance. Results of the second study suggest a pattern of interference very similar to that of the first study. It also found that concrete sentences consistently produced fewer errors than abstract sentences, which could be attributable to a number of factors or processes. (MSE)

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DEVELOPMENTAL CHANGES IN VISUAL AND AUDITORY INTERFERENCE PATTERNS FOR BILINGUAL HIGH SCHOOL STUDENTS

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DEVELOPMENTAL CHANGES IN VISUAL AND AUDITORY INTERFERENCE PATTERNS FOR BILINGUAL HIGH SCHOOL STUDENTS

Introduction

The present paper deals with two experimental studies on German-Swedish bilingual high school students. Both are developmental studies with length of residence in Sweden as the main independent variable. The purpose was to follow the developmental changes in intra- and interlingual interference and to find out whether these interference patterns are related to intelligence as measured by a non-verbal test. In the first study Stroop tasks for vision were used, in the second study dichotic translation tasks for the auditory modality.

The reasons for doing these studies were: (1) For the bilingual case there do not exist any developmental studies with Stroop tasks. (2) Those who have used Stroop tasks with bilingual subjects (Dyer 1971, Ehri and Ryan 1980, Hamers and Lambert 1972, Preston and Lambert 1969) have generally found higher amounts of intralingual interference, however, somewhat task dependent. In Preston and Lambert's study equivalent amounts of the two types of interference were found when the color words in the two languages resembled each other. What one should expect for any task are equivalent amounts of interference at least during certain periods. (3) In all previous studies considerable amounts of interference from the other language were found, too, and taken as evidence for the interdependence hypothesis of bilingual storage. Thus, the results of the present study were expected to increase our knowledge about the structure of bilingual memory in terms of common or separate storage. (4) Whereas the effect of bilingualism on intelligence has been the topic of many research projects, the effect of intelligence on bilingualism has been largely ignored (McLaughlin 1978). If one assumes

that linguistic functioning is closely dependent on cognitive functioning (Bever 1970, Macnamara 1970), Stroop task performance and performance on Raven's Progressive Matrices should be correlated, not necessarily with the simple naming conditions, but with the interference conditions of reading over naming.

In previous studies with monolingual subjects the relation between Stroop scores and intelligence was found to be tenuous. However, those studies mostly used college students and the correlations may have been depressed somewhat by the restricted range of ability. As the present study uses high school students who are supposed to be more heterogeneous groups, the correlations are expected to be stronger, especially since Stroop task performance in this case requires a good mastery of more than one language.

Method

Material. For the visual modality both color-word interference tasks were used where the color words in German and Swedish are similar, and picture-word interference tasks where the words in the two languages are less similar and tap a greater variety of semantic relations.

In the Stroop color-word task the time it takes to name colors printed in semantically incongruent color words is compared to the time it takes to name colored patches or Xs in a control condition. The bilingual form of the test presents the color words in one language with the instruction that the ink colors are to be named in the bilingual's second language. Stroop color interference cards were constructed with 50 color words per card. On one card the interfering words were written in Swedish (blå, gul, röd, grön), on a second card in German (blau, gelb, rot, grün). A third control card consisted of triple Xs written in blue, yellow, red, and green inks.

In the picture-word interference task six sheets of ten pictures each, depicting common objects like table and pencil, served as stimuli. The interference condition was established by distractor words belonging to the same semantic category as the pictures, e.g., the word "knife" was placed in the middle of the pictured object "scissors". Twenty German and 20 Swedish distractor words were superimposed on 40 pictures. In the control condition a sequence of Xs was placed on 20 pictures, covering approximately the same space on them as the distractor words.

Procedure. The subjects were tested individually in sessions that lasted about 60 minutes. Each subject performed the following six tasks, three in each language: (1) named the colored series of Xs in German, (2) named the colors of German color-words in German (interlingual condition); (3) named the colors of Swedish color-words in German (interlingual condition; (4) named the colored series of Xs in Swedish, (5) named the colors of Swedish color-words in Swedish (intralingual condition), and (6) named the colors of German color-words in Swedish (interlingual condition).

Similarly, the six experimental conditions in the picture-word task were run in counterbalanced order. Likewise there was an intra- and an interlingual condition for both Swedish and German languages. In each condition the subjects were instructed to label the pictures as quickly as possible and to ignore the words. All sessions were taped and timed later.

After the Stroop tasks each subject was tested with Raven's Progressive Matrices, a non-verbal intelligence test.

Subjects. The subjects were 89 volunteer high school students of the German School in Stockholm, a private school with 570 studetns ranging from preschool to grade 13. Instruction is in German and Swedish at both elementary and high school level, with German the dominant classroom language. The students are taught Swedish history, political science, and Swedish language in Swedish by Swedish teachers. The other topics are taught by German teachers, who hold multiannual contracts.

The German-Swedish bilingual group consisted of 74 subjects. For all these subjects German was the home language and the first language, at least during the initial years of residence in Sweden. Swedish was acquired outside the home in a natural milieu. Thus, both languages were acquired in informal environments as well as in formal training situations in school. Generally, after some years of bilingual training the students handle both languages with the competence of a native speaker.

A trilingual group of 15 subjects participated, too. Beside German and Swedish, the subjects had a third language as a daily medium of contact: Spanish (6), English (2), Danish (2), Hungarian (2), Finnish (1), French (1), and Yugoslavian (1), respectively. In some cases the third language was the language at home; in most instances only one parent spoke this language with the child.

Design. The study, which has a cross-sectional approach, is longitudinal, covering a period of 16 years, with length of residence in Sweden as the independent and response times on Stroop tasks as the dependent variable. The 74 bilingual students were divided into five groups, according to residence in Sweden. The age in each group varied between 14 and 19 years, but the mean age in the different groups was very uniform around 16 years.

To examine the influence of several language systems on Stroop task performance, the response time scores of 15 bilingual and 15 trilingual subjects were compared. The groups were matched for age (mean = 16.2 years), length of residence in Sweden (mean = 5.6 years), and results on Raven's Progressive Matrices (mean = 34 points).

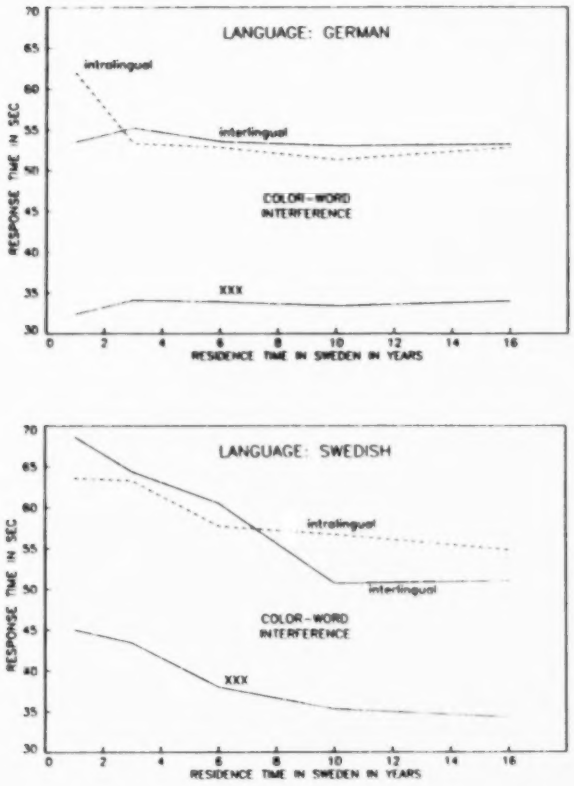
Results

Figure 1 shows the results for the color-word interference tasks. As can be seen in the left half of the figure, the students are more distracted by the German color words than by the Swedish color words on arrival in Sweden from Germany. Intralingual interference then decreases continuously and after about three years there is a short shifting point at which intra- and interlingual interference are equivalent. After that interlingual exceeds intralingual interference over a period of 13 years. The differences are, however, insignificant. In the simple naming condition there is a slight increase of response times over years from 32 to 34 seconds.

When Swedish is the language of response, again German color words lead to most interference for students with a short residence in Sweden. In this case it is interlingual interference that dominates, but the differences in the new language are less marked. When Swedish is on the way to becoming the better language, the Swedish words lead to higher amounts of interference. The differential pattern of intra- and interlingual interference resembles that when German is response and dominant language after a short residence in Sweden.

For the picture-word task the development is similar to the color-word task: considerable amounts of intra- and interlingual interference at all stages. The shifting point is somewhat later, presumably due to the fact that the task is more difficult. The increase in response times for the simple

Fig. 1. Development of intra- and interlingual interference in Stroop colorword tasks as a function of residence in Sweden. German is the response language on the left, Swedish on the right.

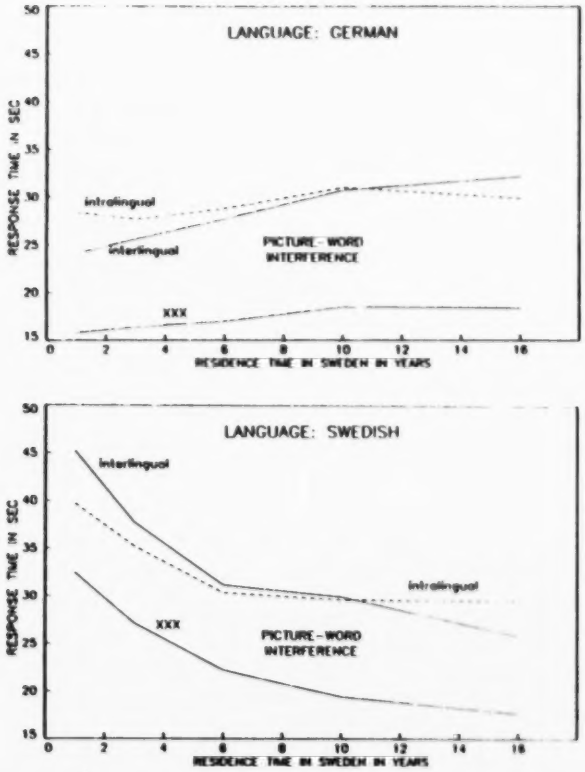


naming condition is more pronounced here and clearly significant in both languages when the group with a short residence is compared to the group with a residence of 16 years in Sweden.

In conclusion: The differential pattern of interference is mainly determined by language dominance with equivalent amounts of intra-

and interlingual interference for subjects who are about equally adept at the tasks in both languages and higher amounts of interference from one language when this language is clearly dominating. This interference pattern is not task dependent, the task determines only the shifting point or the point of language balance, i.e., the more difficult the task the longer it takes to achieve points of equivalence.

Fig. 2. Development of intra- and interlingual interference in picture--word interference tasks as a function of residence in Sweden. German is the response language above, Swedish below.



Unfortunately, the interference pattern cannot be taken as evidence for or against a hypothesis of interdependence, since the Stroop task does not permit one language to be turned off completely because competing stimuli for the other language are always present. The bilingual may not confuse the languages, but lexical selection is still a problem. The subject cannot avoid seeing the word, when responding to the color; conflict is inevitable. There are always both types of interference which do not say anything about the storage of the languages, only about their usage.

What could be taken as evidence for an interdependent hypothesis of language systems, i.e., a common storage for words at the semantic level – at least for certain words that are language unspecific and share identical meanings in the two languages – are the somewhat increased response times in the naming conditions. This phenomenon is discussed in previous studies (Mägiste 1979a, 1979b, 1980a, 1980b, 1982a) and analyzed in terms of automaticity and interference (Mägiste 1982b) where the strong interrelation of these two concepts is shown.

Table 1 shows the correlations between Stroop tasks and Raven's Matrices when residence time is partialed out. For the bilingual group most correlations are around zero, in German two out of six, in Swedish one out of six possible correlations reach significance. The results must be taken with caution, since no subject in this group performed below the normal range of

Table 1. Partial correlations between performance on Stroop tasks and Raven's Progressive Matrices with length of residence held constant.

Group	German		Swedish		Naming	
	col-w	pict-w	col-w	pict-w	col	pict
Biling	-.18	.07	-.26^{xx}	.04	-.20^{xx}	.03
Germ	-.20^{x}	-.07	-.06	.10	-.16	-.15
Swed						
Triling						
Germ	-.01	.15	-.09	-.03	.05	-.14
Swed	-.49^{x}	-.34	-.54^{xx}	-.50^{x}	-.53^{xx}	-.59^{xx}

$^{x}p<.05$, $^{xx}p<.025$.

intelligence; the mean result for the bilingual group was clearly above average. It is interesting to note that the tasks which obviously are easy for this highly selected bilingual group turn into demanding tasks for trilingual subjects who have Swedish as their third language. This is also indicated by the longer response times for Swedish when compared to German (see Table 2 below).

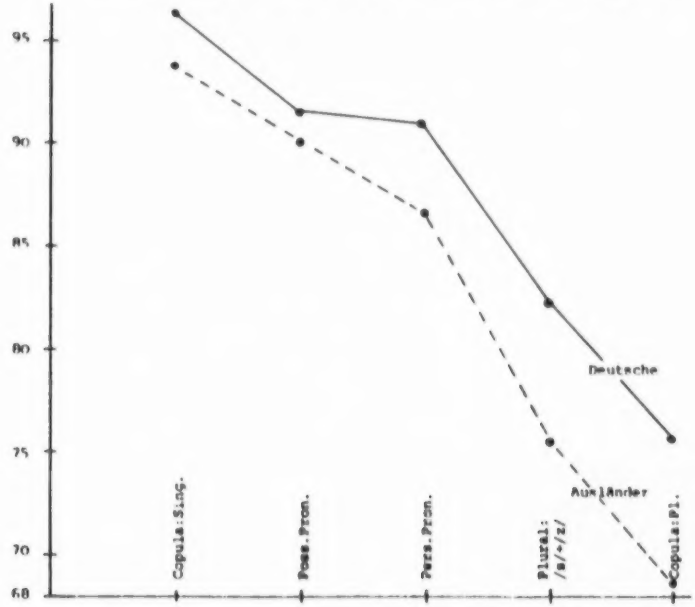
Matched on the basis of age, intelligence and residence time, the trilingual subjects are somewhat slower in both their second and third language than bilinguals in their first and second. The results are in line with Jung 1981, who compared the acquisition process of English grammar in German monolingual and bilingual immigrant children. He found that the order of acquisition was the same in both groups though somewhat later in the bilinguals.

Psychologists generally believe that people who become bilingual at an early stage will later have more facility in picking up a third language (Albert and Obler 1978), which might be the case at certain metalinguistic levels, but truly not at this very elementary level.

Table 2. Mean response times in seconds for bilingual and trilingual subjects in Stroop tasks as a function of language systems as parameter.

	German		Swedish		Naming	
Group	col-w	pict-w	col-w	pict-w	col	pict
Biling						
Germ	54.1	28.7	52.7	27.0	33.4	15.6
Swed	62.8	34.5	60.0	32.6	38.9	24.1
Triling						
Germ	61.4	31.6	57.9	31.6	35.9	20.1
Swed	62.4	37.0	63.3	37.3	42.1	27.3

Fig. 3. Mean percent correct in different English grammar tasks for immigrant (bilingual) and German (monolingual) children. From: U. Jung 1981.



Dichotic translation

To see whether interference effects for the auditory modality correspond to the visual case, a dichotic translation task was used with concrete and abstract sentences to be translated from German into Swedish. In every sentence there were always two concrete or two abstract nouns high in frequency, for example: "The child shuts the door" and "The work takes time".

Two groups of 20 subjects each participated, one with a clear dominance for German with a 25 seconds difference in reading speed for equivalent German and Swedish texts, and one with Swedish as the better language. This group read the Swedish text which consisted of 105 words 3 seconds faster than the German text.

There was simultaneous presentation of 60 sentences to both ears and the instruction was to translate those presented to the right ear and to ignore those presented to the left. The time left for translation was shorter than the presentation time. The task was perceived as highly unpleasant by nearly all subjects.

Results

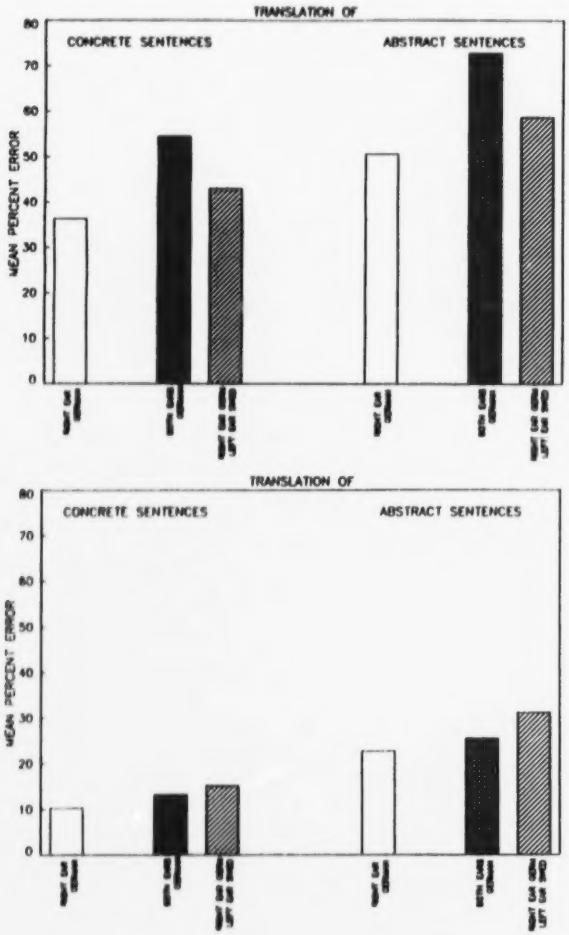
The upper half of Figure 4 presents the results of the German group with a mean of 1.5 years of residence in Sweden. In both types of sentences the students are clearly more distracted when German is on the irrelevant channel than when Swedish sentences are presented to the other ear. In the control condition with presentation to one ear only, the students perform clearly better. In keeping with the Stroop tasks for vision, interference seems inevitable, at least at this stage of incomplete mastery of a second language.

The lower half of Figure 4 shows the results of the Swedish group. After 16 years of bilingual schooling, this group is of course highly proficient in both languages as indicated by the low error rates in all conditions. There is a slight tendency for higher error rates when Swedish stimuli are on the irrelevant channel as opposed to German. In all three conditions the subjects perform about the same. Obviously, with a very good command of a language it is quite possible to ignore irrelevant stimuli which seems to be impossible at earlier stages of language development.

The differential pattern of the two interference conditions is very much alike the visual case. The differences here are somewhat less marked which is in line with results in other areas where output interference is generally greater for visual than for auditory items (Nilsson, Wright and Murdock 1979, Watkins, Watkins and Crowder 1974).

That concrete sentences consistently produced less errors than abstract sentences could be easily explained by Paivio's (1969) dual coding hypothesis which means that concrete sentences have both the verbal and the imagery code, abstract sentences only the verbal code. However, there seem to be other explanations. The most common argument against dual coding are differences in comprehensiveness between the two types of sentences. In the German group some subjects reported afterwards that they had more diffi-

Fig. 4. Mean percent error in dichotic translation as a function of language dominance: worse translation for the German dominant group (upper half of the figure) when both ears receive German stimuli than when one ear receives German and the other Swedish stimuli; the reverse pattern is found in the Swedish dominant group (lower half of the figure).



culties with the abstract sentences. If the abstract sentences generally were more difficult for all subjects, one could expect the correlations with intelligence to be higher for the more difficult task. As indicated by Table 3, the error rates in all translation tasks clearly correlate with Raven's Matrices, but there are no differences between the concrete and abstract conditions.

Table 3. Partial correlations between error rates and Raven's Matrices with length of residence held constant.

	Translation of					
	concrete sentences control- interference conditions			abstract sentences control- interference conditions		
Bilinguals n = 40	$-.28^{x}$	$-.46^{xxx}$	$-.54^{xxx}$	$-.39^{xx}$	$-.29^{x}$	$-.48^{xxx}$

$^{x}p<.05$, $^{xx}p<.01$, $^{xxx}p<.005$.

There seems to be another important factor behind the higher error rate for abstract sentences: Concrete and abstract words differ in degree of automaticity for children who learn abstract words later than concrete words. Words can be equally frequent in usage for adults according to frequency dictionaries, but still differ in degree of automaticity, which first becomes evident in highly time-limited tasks. This is certainly most pronounced in young people and in a second language which is usually acquired after the first language.

FOOTNOTE

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REFERENCES:

Albert, M.L. and Obler, L.K. (1978), *The Bilingual Brain*. New York: Academic Press.

Bever, T.G. (1970), The cognitive basis for linguistic structures. Hayes, J.R. (ed.), *Cognition and the Development of Language*. New York: Wiley.

Dyer, F.N. (1971), Color-naming interference in monolinguals and bilinguals. *Journal of Verbal Learning and Verbal Behavior*, 10, 297-302.

Ehri, L.C. and Ryan, E.B. (1980), Performance of bilinguals in a picture-word interference task. *Journal of Psycholinguistic Research*, 9, 285-302.

Hamers, J.F. and Lambert, W.E. (1972), Bilingual interdependencies in auditory perception. *Journal of Verbal Learning and Verbal Behavior*, 11, 303-310.

Jung, U.O.H. (1981), Englisch als Fremdsprache für Kinder mit Deutsch als Zweitsprache. *Grazer Linguistische Studien*, 14, 83-97.

Macnamara, J. (1972), Cognitive basis of language learning in infants. *Psychological Review*, 79, 1-14.

McLaughlin, B. (1978), *Second Language Acquisition in Childhood*. New York: Erlbaum.

Mägiste, E. (1979a), The competing language systems of the multilingual: a developmental study of decoding and encoding processes. *Journal of Verbal Learning and Verbal Behavior*, 18, 79-89.

Mägiste, E. (1979b), Recall of concrete and abstract sentences in bilinguals. *Scandinavian Journal of Psychology*, 20, 179-185.

Mägiste, E. (1980a), Memory for numbers in monolinguals and bilinguals. *Acta Psychologica*, 46, 63-68.

Mägiste, E. (1980b), Arithmetical calculations in monolinguals and bilinguals. *Psychological Research*, 42, 363-373.

Mägiste, E. (1982a), Automaticity and interference in bilinguals. *Psychological Research*, 44, 29-43.

Mägiste, E. (1982b), The importance of language strategy in mental arithmetic. *Educational Psychology*, 2, 159-166.

Nilsson, L.G., Wright, E. and Murdock, B.B. (1979), Order of recall, output interference, and the modality effect. *Psychological Research*, 41, 63-78.

Paivio, A. (1969), Mental imagery in associative learning. *Psychological Review*, 76, 241-263.

Preston, M.S. and Lambert, W.E. (1969), Interlingual interference in a bilingual version of the Stroop color-word task. *Journal of Verbal Learning and Berbal Behavior*, 8, 295-301.

Watkins, M.J., Watkins, O.C. and Crowder, R.G. (1974), The modality effect in free and serial recall as a function of phonological similarity. *Journal of Verbal Learning and Verbal Behavior*, 13, 430-447.